WE CLAIM:

1. An electrode for electrochemical splitting of water comprising:

a light sensitive catalytic material layer;

a polymer electrolyte membrane layer;

a metallic substrate layer disposed there between adjacent said polymer electrolyte membrane layer; and

at least one photovoltaic device connected in series to said light sensitive catalytic material layer and disposed between said light sensitive catalytic material layer and said metallic substrate layer, each of said light sensitive catalytic material layer, said polymer electrolyte membrane layer, said metallic substrate layer and said at least one photovoltaic device being water permeable.

2. An electrode in accordance with Claim 1, wherein at least two said photovoltaic devices connected in series are disposed between said light sensitive catalytic material layer and said metallic substrate layer.

3. An electrode in accordance with Claim 1, wherein said light sensitive catalyst material layer comprises an n-type semiconductor.

4. An electrode in accordance with Claim 1, wherein said light sensitive catalyst material layer comprises a p-type semiconductor.

5. An electrode in accordance with Claim 1, wherein said at least one photovoltaic device is a p-i-n device.

6. An electrode in accordance with Claim 1, wherein said polymer electrolyte membrane layer is a proton exchange membrane.

7. An electrode in accordance with Claim 1, wherein said polymer electrolyte membrane layer comprises a material selected from the group consisting of polyimide and perfluorosulfonate ionomers.

8. An electrode in accordance with Claim 1, wherein said light sensitive catalytic material layer comprises a wide band gap semiconductor.

9. An electrode in accordance with Claim 8, wherein said wide band gap semiconductor comprises a material selected from the group consisting of TiO_2, carbon black, perfluorosulfonate ionomer emulsion binder, an electrically conductive polymer, an electron conductive polymer, a proton conductive polymer and combinations thereof.

10. An electrode in accordance with Claim 1, wherein said light sensitive catalytic material layer comprises a catalyst selected from the group consisting of Pt, Ni, Fe, Ti, light sensitive dyes and combinations thereof.

11. An apparatus comprising:

a housing having at least one light transmissive wall;

at least one water permeable photoelectrode disposed in said housing, said at least one water permeable photoelectrode comprising a first light sensitive catalytic material layer disposed at a distance from said at least one light transmissive wall and having a side facing said at least one light transmissive wall, a first polymer electrolyte membrane layer disposed on a side of said first light sensitive catalytic material layer opposite said side facing said at least one light transmissive wall, a first metallic substrate layer disposed between said first light sensitive catalytic material layer and said first polymer electrolyte membrane layer and adjacent said first polymer electrolyte membrane layer, and at least one photovoltaic device disposed between said first light sensitive catalytic material layer and said first metallic substrate layer and connected in series with said first light sensitive catalytic material layer;

an additional electrode of opposite polarity from said at least one water permeable photoelectrode disposed within said housing at a distance from said at least one water permeable photoelectrode; and

a water-based electrolyte disposed substantially only between said at

least one water permeable photoelectrode and said additional electrode.

12. An apparatus in accordance with Claim 11, wherein said additional electrode is a second said water permeable photoelectrode having a second said light sensitive catalytic material layer disposed at a distance from a second said light transmissive wall.

13. An apparatus in accordance with Claim 11, wherein said at least one water permeable photoelectrode comprises at least two said photovoltaic devices connected in series.

14. An apparatus in accordance with Claim 11, wherein said light sensitive catalyst material layer comprises an n-type semiconductor.

15. An apparatus in accordance with Claim 11, wherein said light sensitive catalyst material layer comprises a p-type semiconductor.

16. An apparatus in accordance with Claim 11, wherein said at least one photovoltaic device is a p-i-n device.

17. An apparatus in accordance with Claim 11, wherein said polymer electrolyte membrane layer is a proton exchange membrane.

18. An apparatus in accordance with Claim 11, wherein said polymer electrolyte membrane layer comprises a material selected from the group consisting of polyimide and perfluorosulfonate ionomers.

19. An apparatus in accordance with Claim 11, wherein said first light sensitive catalytic material layer comprises a wide band gap semiconductor.

20. An apparatus in accordance with Claim 12, wherein at least one of said first light sensitive catalytic material layer and said second light sensitive catalytic material layer comprises a wide band gap semiconductor.

21. An apparatus in accordance with Claim 19, wherein said wide band gap semiconductor comprises a material selected from the group consisting of TiO_2, carbon black, perfluorosulfonate ionomer emulsion binder, an electrically conductive polymer, an electron conductive polymer, a proton conductive polymer and combinations thereof.

22. An apparatus in accordance with Claim 11, wherein said first and second light sensitive catalytic material layers comprise a catalyst selected from the group consisting of Pt, Ni, Fe, Ti, light sensitive dyes and combinations thereof.

23. An apparatus comprising:

a light transmissive enclosure having a hydrogen gas outlet opening and an oxygen gas outlet opening;

at least two water permeable photoelectrodes disposed at a distance from each other in said enclosure, each said water permeable photoelectrode comprising a light sensitive catalytic material layer disposed at a distance from a light transmissive wall of said light transmissive enclosure and facing said light transmissive wall, one of said light sensitive catalytic material layers in fluid communication with said hydrogen gas outlet opening and the other of said light sensitive catalytic material layers in fluid communication with said oxygen gas outlet opening, a polymer electrolyte membrane layer disposed on a side of said light sensitive catalytic material layer facing away from said light transmissive wall, a metallic substrate layer disposed between said light sensitive catalytic material layer and said polymer electrolyte membrane layer and adjacent said polymer electrolyte membrane layer, and at least one photovoltaic device disposed between said light sensitive catalytic material layer and said metallic substrate layer and connected in series with said light sensitive catalytic material layer; and

a water-based electrolyte disposed within said light transmissive enclosure substantially only on a side of said at least two water permeable photoelectrodes facing away from said light transmissive wall.

24. An apparatus in accordance with Claim 23, wherein said light sensitive catalytic material layer of each said water permeable photoelectrode is facing a same said light transmissive wall of said light transmissive enclosure.

25. An apparatus in accordance with Claim 24, wherein each said water permeable photoelectrodes comprises at least two said photovoltaic devices connected in series.

26. An apparatus in accordance with Claim 24, wherein one of said light sensitive catalyst material layers comprises an n-type semiconductor and the other of said light sensitive catalyst material layers comprises a p-type semiconductor.

27. An apparatus in accordance with Claim 24, wherein at least one of said light sensitive catalytic material layers comprises a wide band gap semiconductor.

28. An apparatus in accordance with Claim 27, wherein said wide band gap semiconductor comprises a material selected from the group consisting of TiO_2, carbon black, perfluorosulfonate ionomer emulsion binder, an electrically conductive polymer, an electron conductive polymer, a proton conductive polymer and combinations thereof.